Groundwater Committee Meeting

November 26, 2019

United Water
CONSERVATION DISTRICT

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Agenda Items 1 through 3

1. Public Comment
2. Approval of the Agenda
3. Approval of the Minutes

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4. FCGMA Agenda Review

Oxnard sub-basin (Oxnard Plain)
Priority: High – **Critically Overdrafted**
Reason: Seawater intrusion, overdraft
GSA: Fox Canyon GMA

Las Posas basin
Priority: High
Reason: Water quality, overdraft
GSA: Fox Canyon GMA

Pleasant Valley basin
Priority: High – **Critically Overdrafted**
Reason: Saline intrusion, overdraft
GSA: Fox Canyon GMA

Last Month's FCGMA BoD Meeting (11/08/19):

- Brief review of public comments on draft GSPs (released in July 2019)
  - Big-picture concerns (e.g., the actual "plan," new projects)
    - Few if any changes proposed in this round of GSPs
    - Can be considered at 5-year review
  - Smaller issues (e.g., water-budget details) and some specific suggestions for language "clarifications"
    - Revisions to be made on a "case-by-case" basis
  - Minimal Board discussion
  - No public comments

Other FCGMA Activities

- TAG:
  - Oct. 31—One agenda item: Discuss public comments on GSPs
    - Not enough TAG members present for quorum
    - Kim Loeb mentioned that the TAG might evolve into a stakeholder group with a new direction
- Two new monitoring wells constructed
  - United staff assisted with aquifer picks for well design

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Key Agenda Items for Dec. 13 BoD Meeting:

- Public hearing to consider adoption of the GSPs for the Oxnard, Pleasant Valley, and Las Posas Valley basins

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5. Mound Basin Groundwater Sustainability Agency (MBGSA) Agenda Review

Mound basin

Priority: High

Reason: Water quality, dependence on groundwater, forecasted population growth

GSA type: JPA

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Recent Activities:

- Nov. 20 regular BoD meeting cancelled
- United working with Executive Director and consultant (Intera) to begin analyzing groundwater-level trends

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Upcoming Agenda Items:

- Next BoD meeting scheduled for December 19
  - Likely to focus on progress, planning for public engagement

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6. Fillmore and Piru Basins Groundwater Sustainability Agency (FPBGSA) Agenda Review

Fillmore basin

Priority: High

Reason: Water quality, dependence on groundwater, forecasted population growth

GSA type: JPA (Fillmore + Piru)

Piru basin

Priority: High

Reason: Water quality, dependence on groundwater

GSA type: JPA (Fillmore + Piru)

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Recent activities:

- October regular BoD meeting cancelled
- November 21 BoD meeting:
  - Focused on outreach and public engagement planning

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Upcoming Agenda Items:

- Next BoD meeting scheduled for December 19
  - Likely to focus on progress, planning for public engagement

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7. Santa Paula Basin Technical Advisory Committee (TAC) Update

Santa Paula basin
Priority: Very Low
Reason: Adjudicated
GSA type: Technical Advisory Committee

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Recent Activities

- TAC meeting on Nov. 7:
  - Progress on "triggers" document for evaluating changes in groundwater levels
  - Review SP Basin Annual Report for 2018

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Upcoming Agenda Items:

- Next TAC meeting scheduled for February 27, 2020
  - Likely to focus on Annual Reports for 2018 and 2019

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8. Update: Brackish-Water Extraction and Treatment System Design Progress

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Coastal Extraction Barrier and Brackish Water Treatment Plant: A Project Concept for Sustainability

Despite long-term efforts to operate the Oxnard Plain and Pleasant Valley basins sustainably, these basins remain critically overdrafted

This project is a possible alternative to significant pumping reductions proposed in the Draft GSPs for the containment of seawater intrusion

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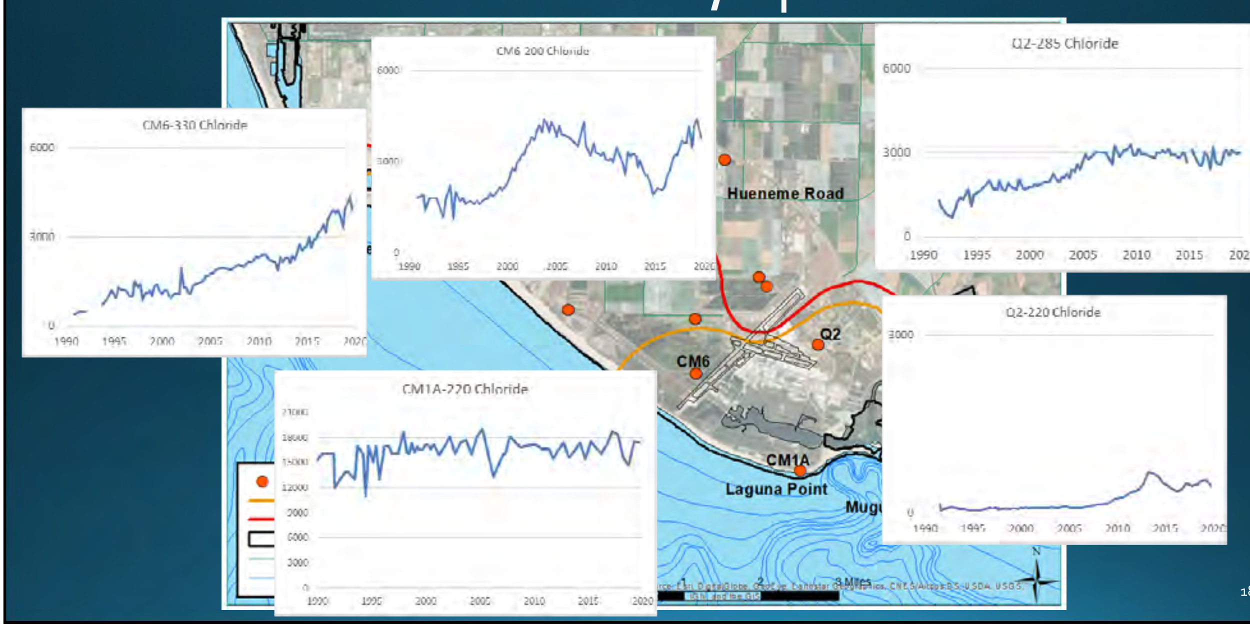
Southern Oxnard Plain, Episodes of SWI



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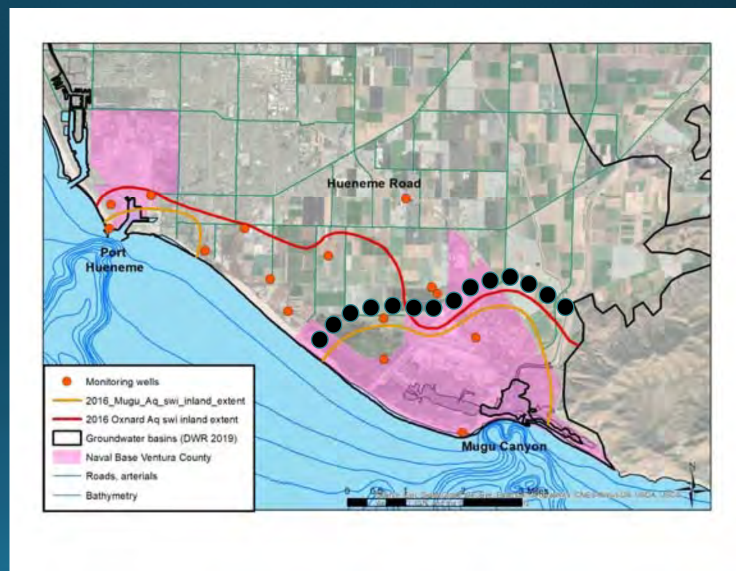
Injection Barrier Concept

Surround areas of degraded water quality with an array of injection wells, closely spaced

Inject enough water to create a groundwater ridge/divide to prevent further inland intrusion

Difficult to site, hard to confirm that an effective barrier is being maintained

What water might be used?



Extraction Barrier Concept

Use extraction wells to create groundwater trough/depression

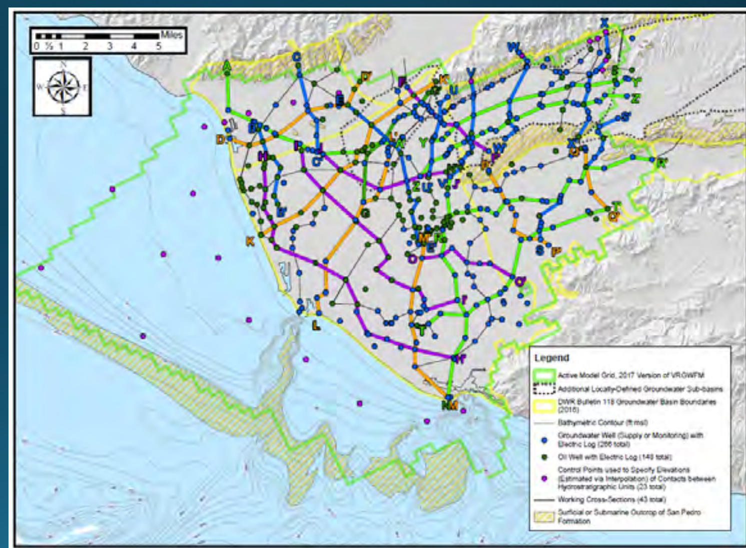
Water flows towards extraction wells from all directions

Seawater should not advance inland past the extraction barrier wells

Treat produced brackish water and put to beneficial use (offset groundwater pumping within the basins)

Cross Section Lines

Aquifers were mapped as part of the development of United's regional groundwater flow model



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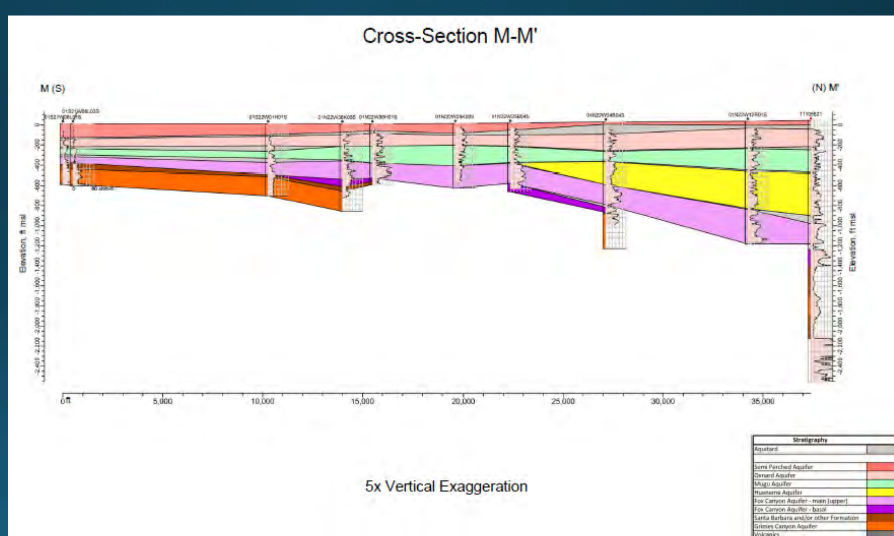
Geologic Cross Section M-M'

- Extends NW from Laguna Point
- Hueneme aquifer eroded away in the greater Mugu area
- Oxnard and Mugu aquifers are highly permeable and lie flat
- Semi-perched aquifer is relatively thick



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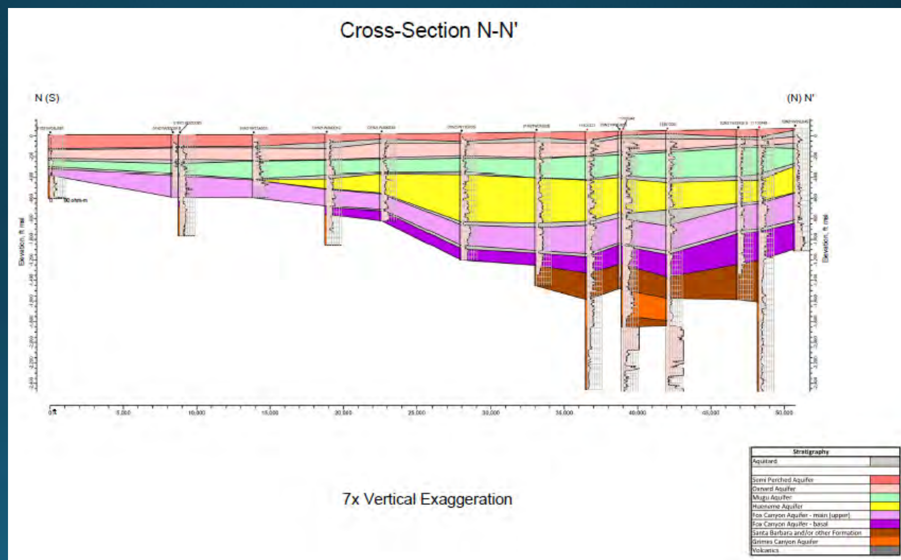
Geologic Cross Section N-N'

Extends north from Laguna Point

Coastline well is at far left of image (Well CM1A)

Mugu aquifer overlies Fox Canyon aquifer in the southern portion of the Oxnard Plain



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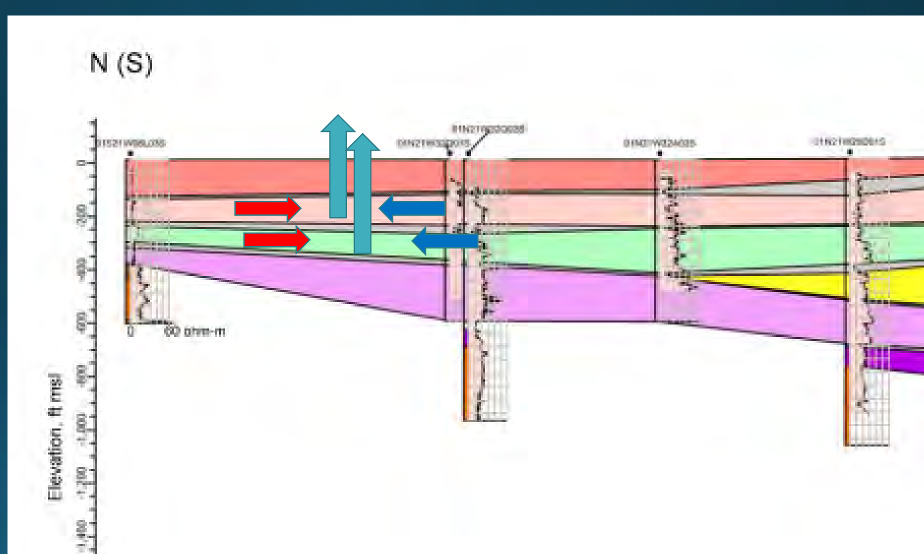
Section N-N' Detail and Horizontal Flow with Project

Extraction wells induce flow towards coastal zone from inland areas

Also onshore flow of seawater



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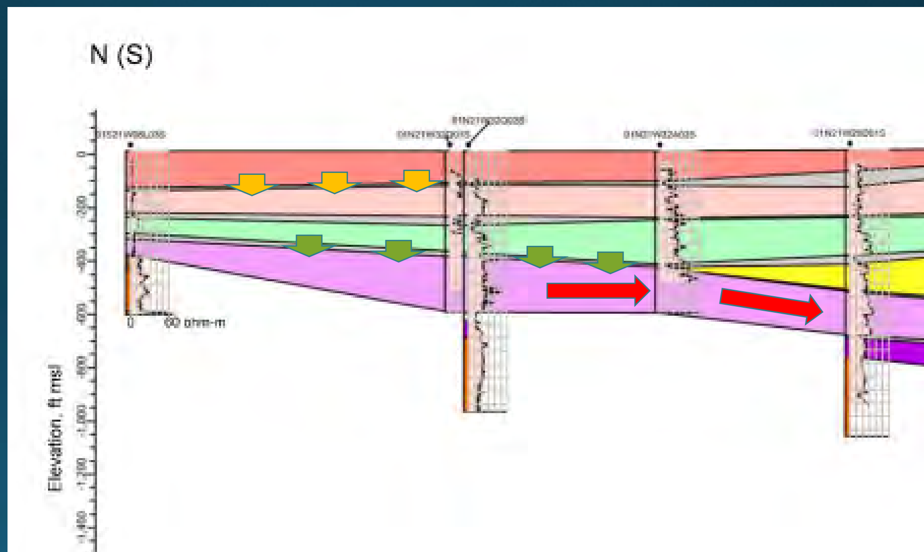
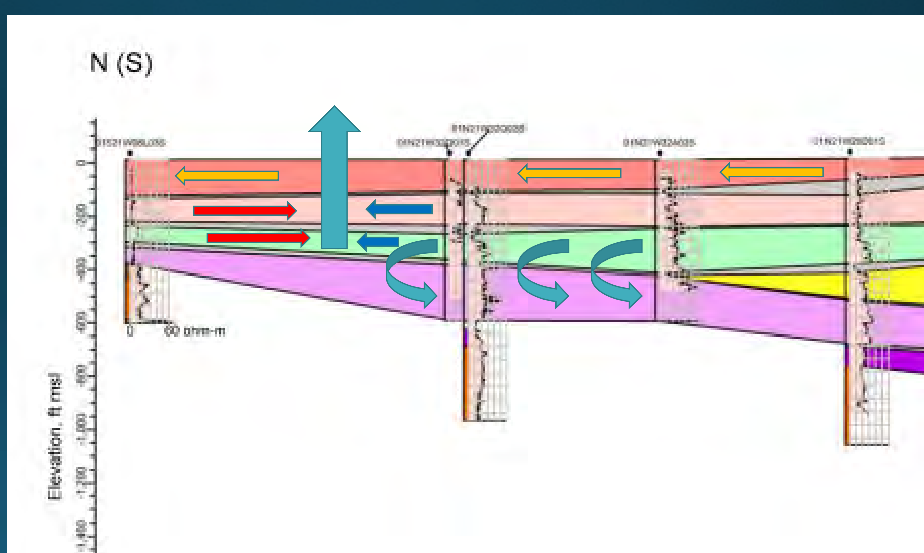
Section N-N' Detail and Vertical Flow with Project

Must assess potential for inducing flow down from the Semi-perched aquifer

Also will assess flow from Mugu aquifer to the underlying FCA, strong downward gradient exists

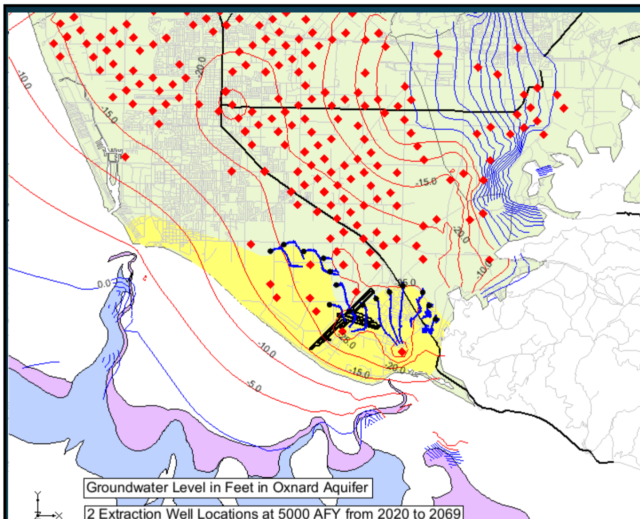


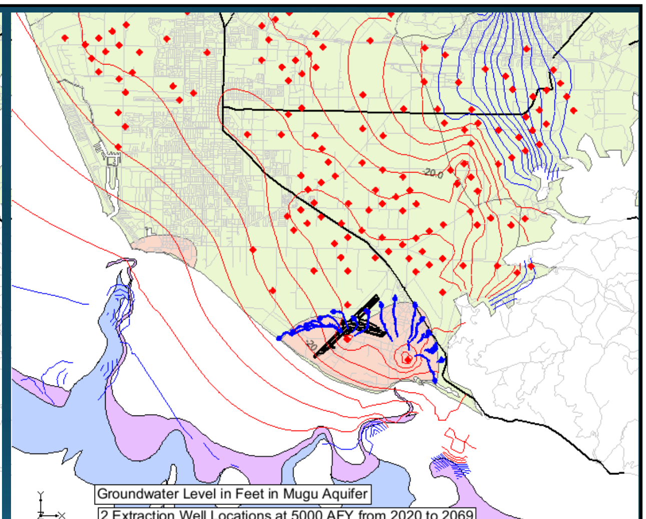
Section N-N' Detail and Conceptual Project Optimal Flow



Preliminary Groundwater Model Scenario

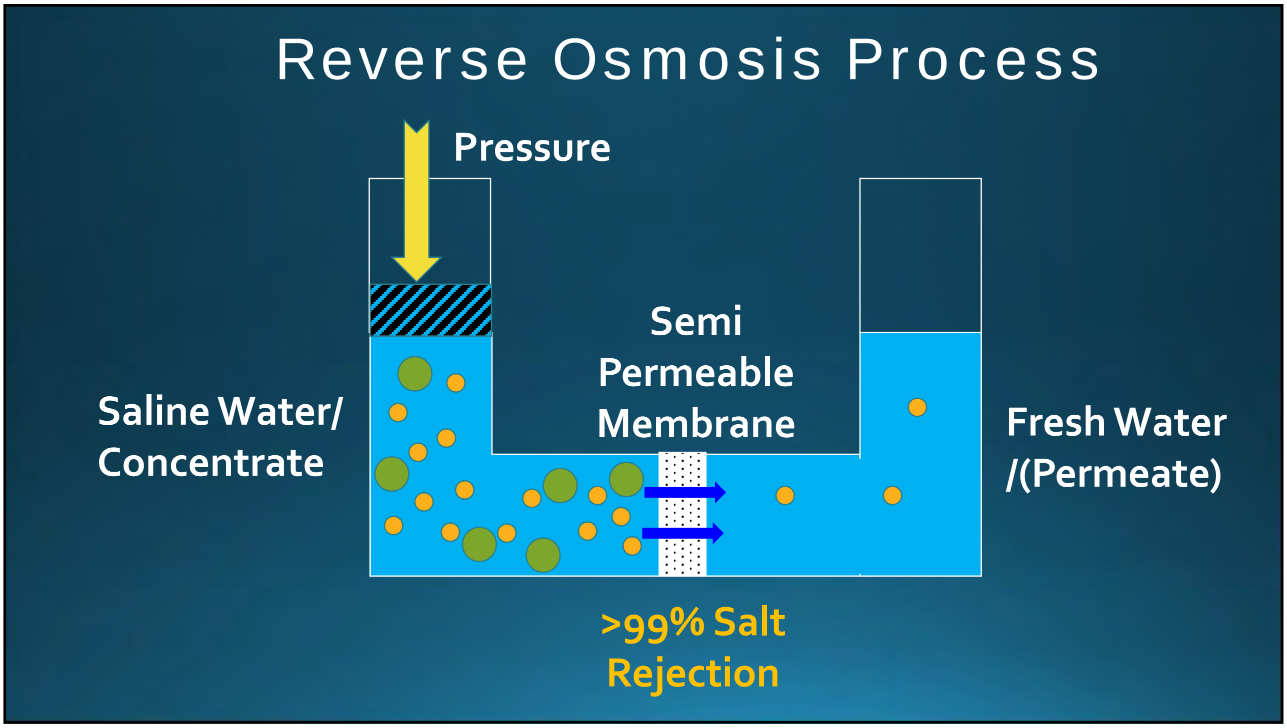
- Extraction Rate: 5,000 acre-ft per year
  - 2,500 AF from Oxnard aquifer
  - 2,500 AF from Mugu aquifer
- Product water from extraction wells not used
- FCGMA's GSP baseline scenario:
  - No pumping reductions
  - No projects

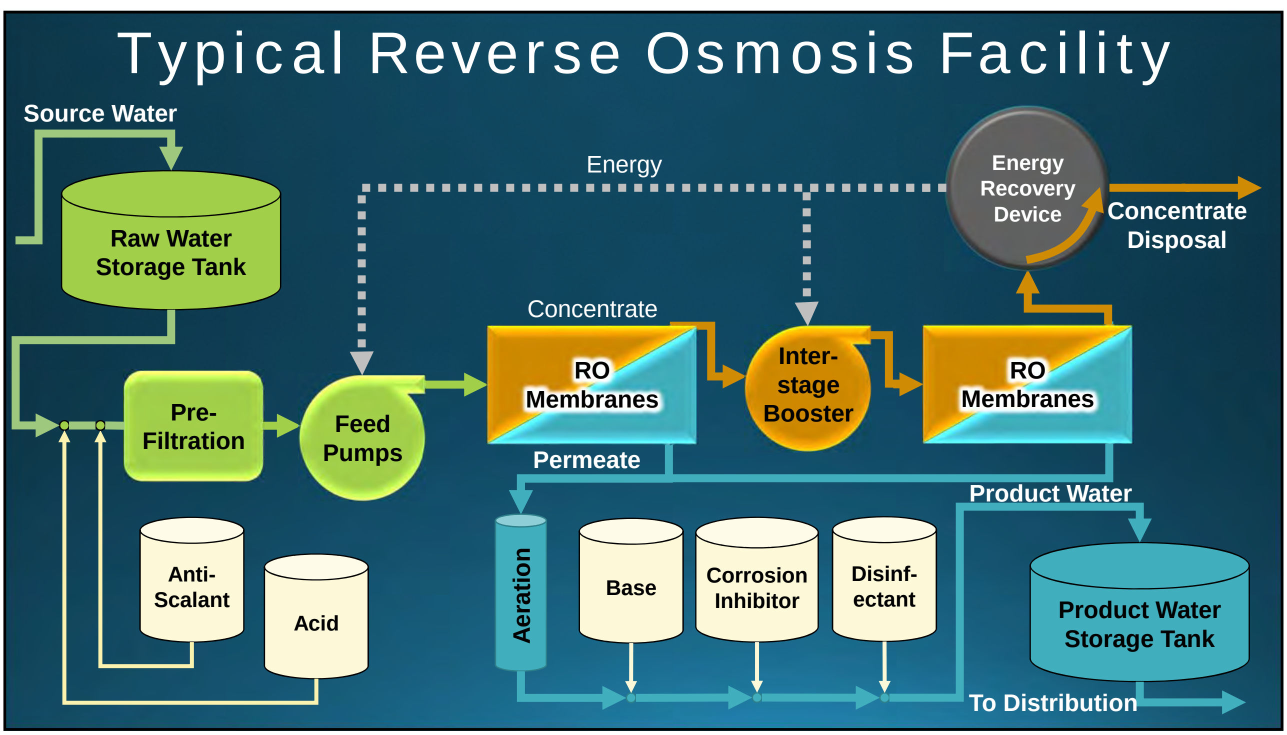


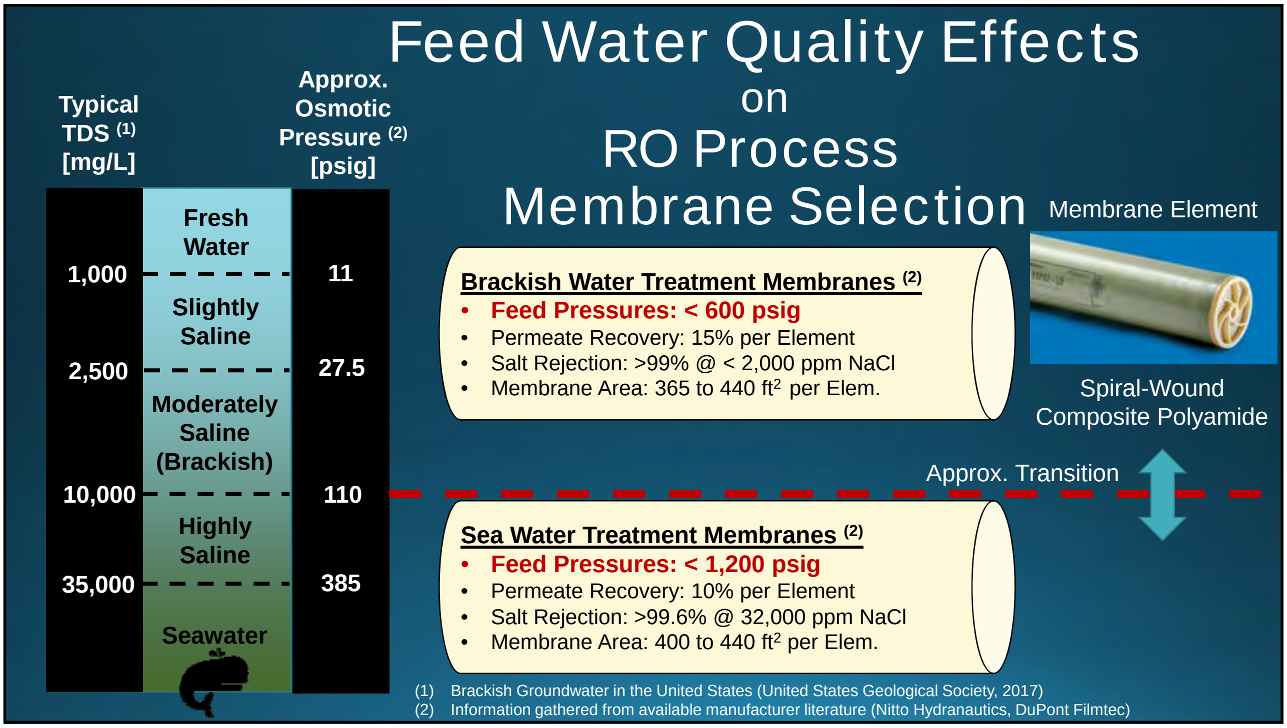


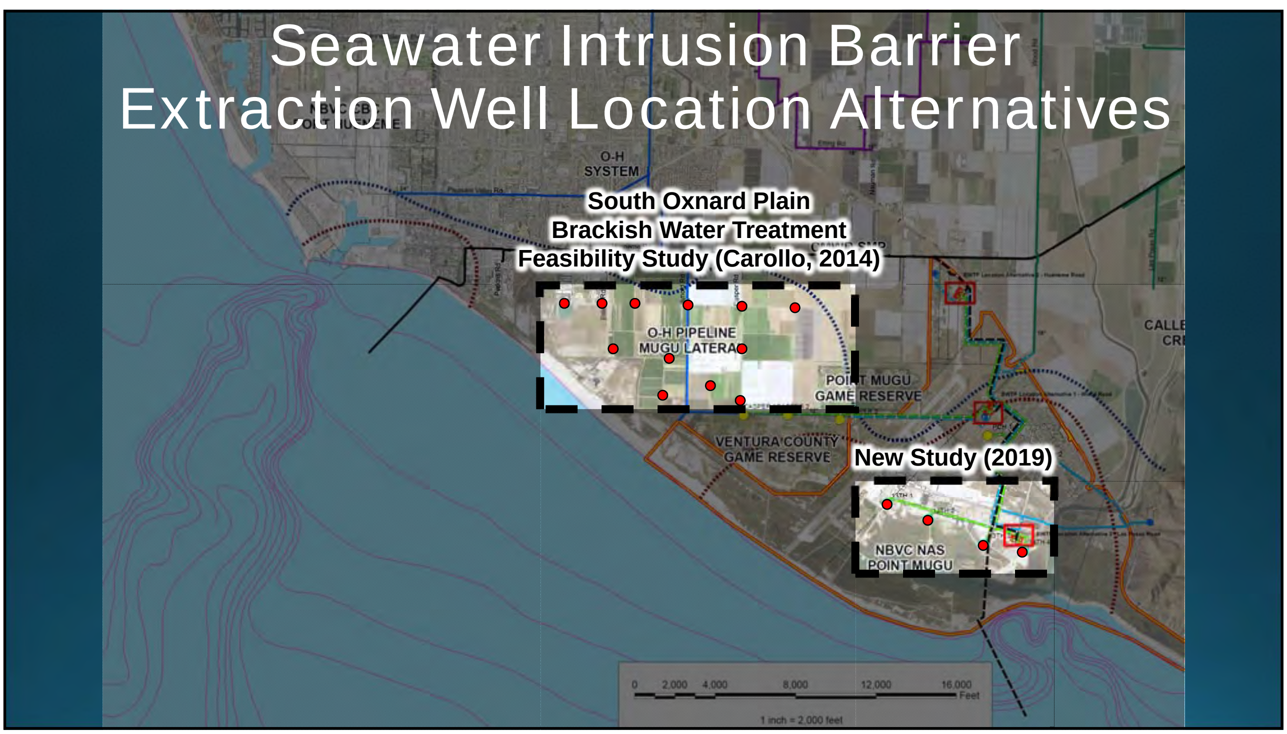
Contour lines: **RED** below sea level, **BLUE** above sea level
Blue lines: Particle tracking paths
Animations in yearly time step from 2020 to 2069

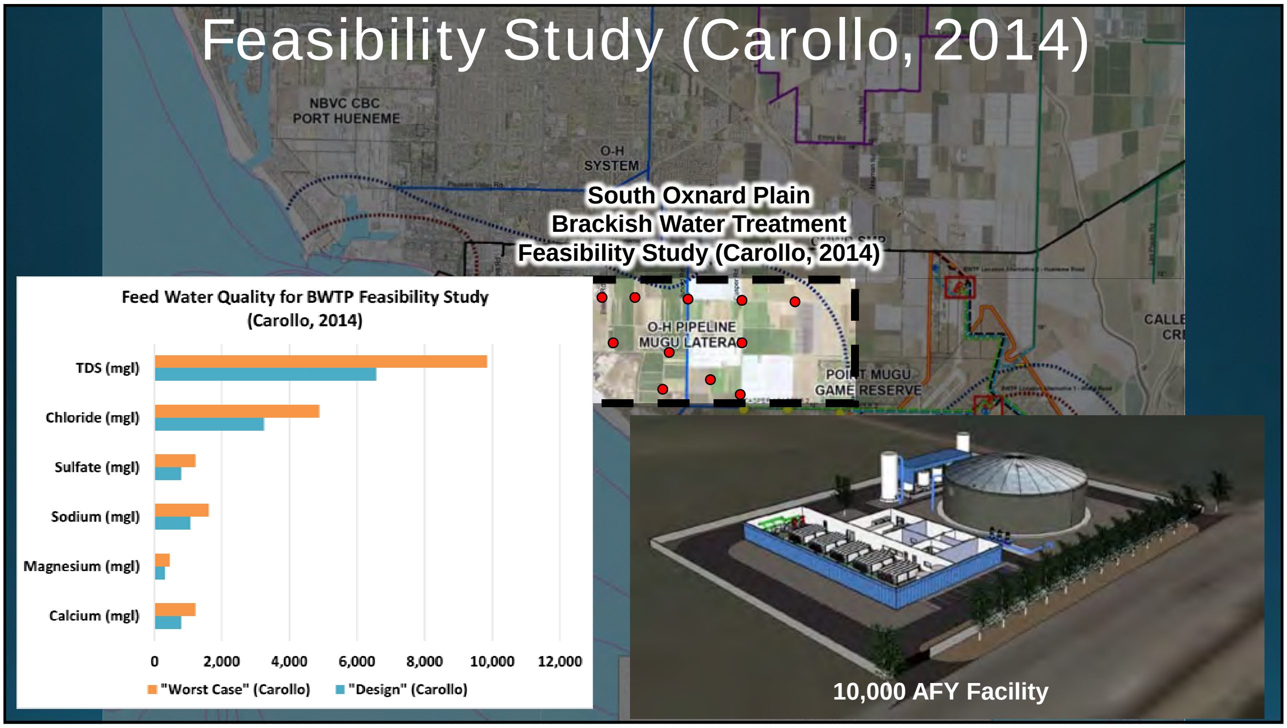
Two well locations with 5,000 AFY
2,500 AFY from Oxnard Aquifer
2,500 AFY from Mugu Aquifer

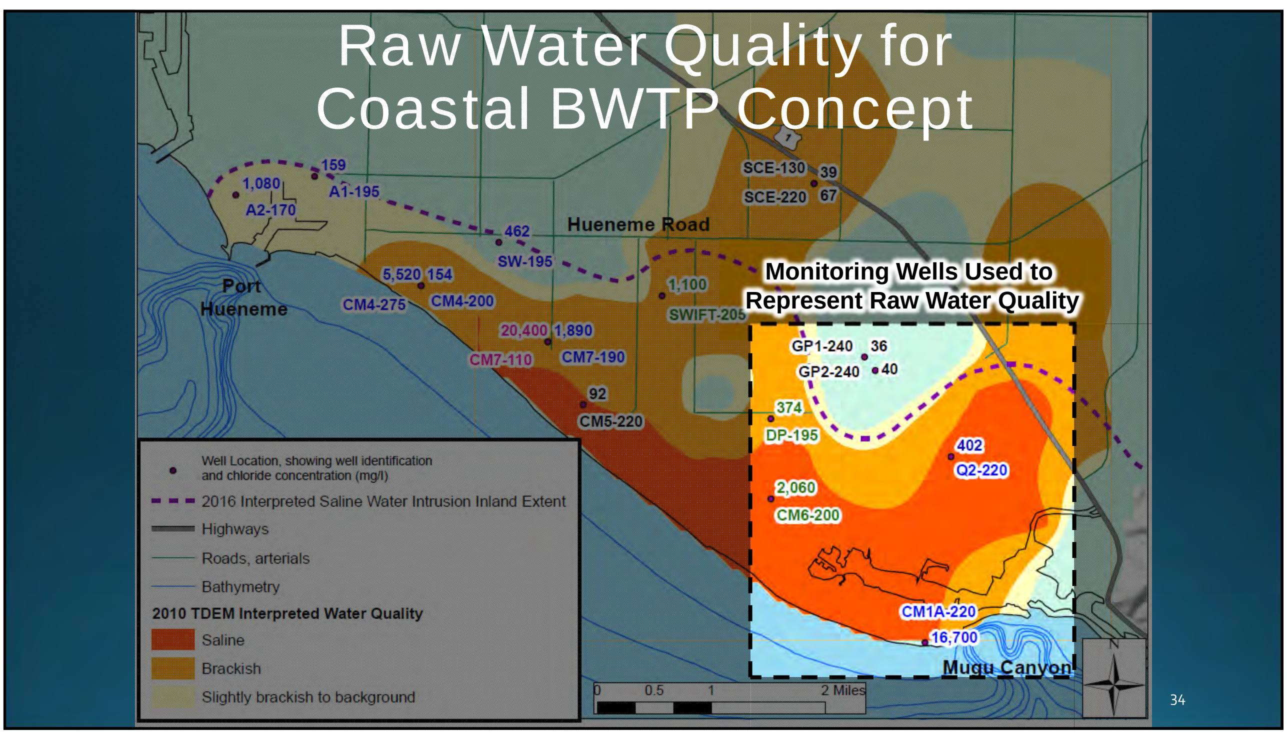

Reverse Osmosis Process
Pressure
Semi
Permeable
Membrane
Saline Water/
Concentrate
Fresh Water
/(Permeate)
>99% Salt
Rejection

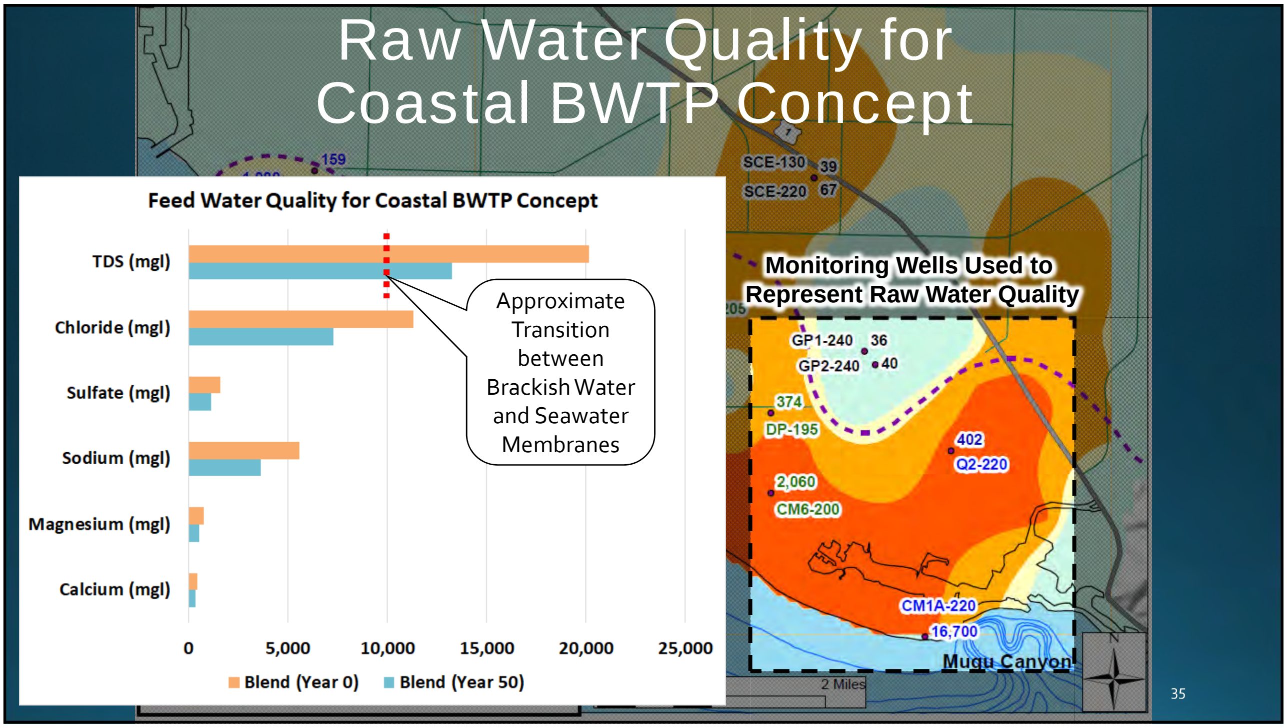

Typical Reverse Osmosis Facility
Source Water
Raw Water
Storage Tank
Energy
Energy
Recovery
Device
Concentrate
Disposal
Concentrate
Pre-
Filtration
Feed
Pumps
RO
Membranes
Inter-
stage
Booster
RO
Membranes
Permeate
Product Water
Anti-
Scalant
Acid
Aeration
Base
Corrosion
Inhibitor
Disinf-
ectant
Product Water
Storage Tank
To Distribution

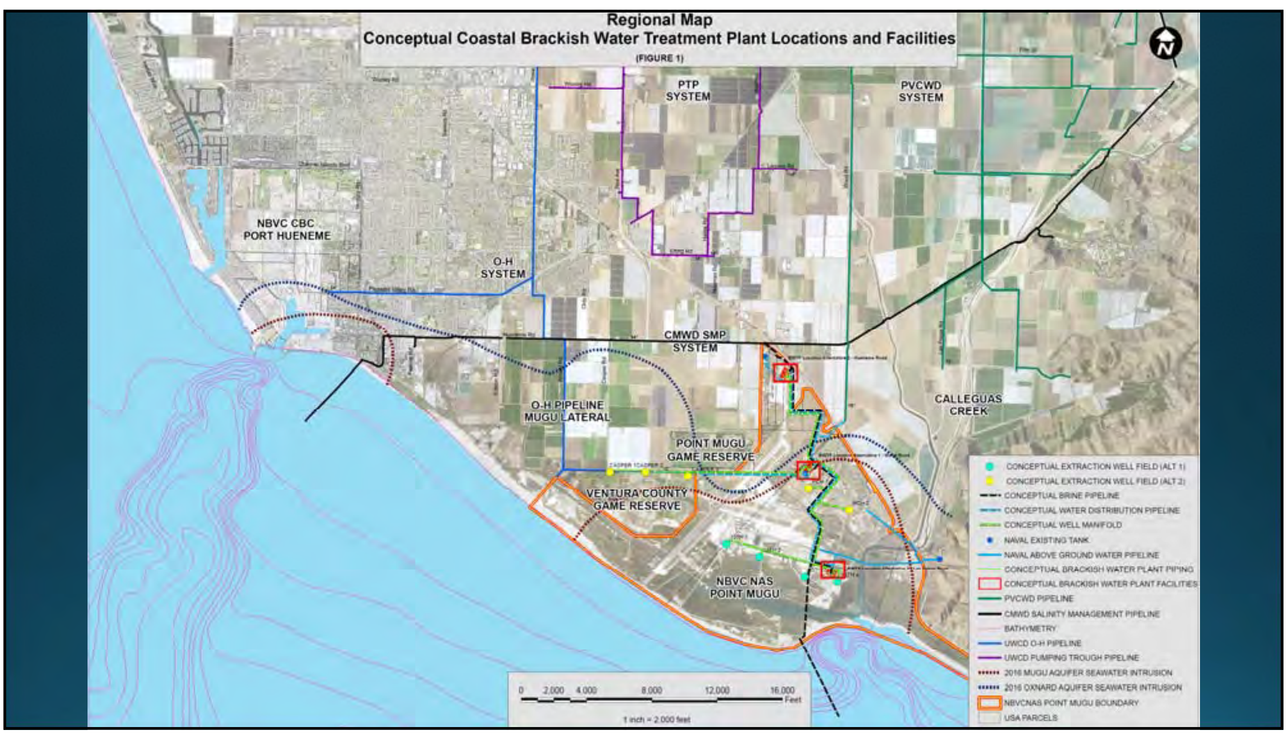

Feed Water Quality Effects
on
RO Process
Membrane Selection
Typical
TDS (1)
[mg/L]
Approx.
Osmotic
Pressure (2)
[psig]
Fresh
Water
1,000
11
Slightly
Saline
2,500
27.5
Moderately
Saline
(Brackish)
10,000
110
Highly
Saline
35,000
385
Seawater
Brackish Water Treatment Membranes (2)
• Feed Pressures: < 600 psig
• Permeate Recovery: 15% per Element
• Salt Rejection: >99% @ < 2,000 ppm NaCl
• Membrane Area: 365 to 440 ft2 per Elem.
Membrane Element
Spiral-Wound
Composite Polyamide
Approx. Transition
Sea Water Treatment Membranes (2)
• Feed Pressures: < 1,200 psig
• Permeate Recovery: 10% per Element
• Salt Rejection: >99.6% @ 32,000 ppm NaCl
• Membrane Area: 400 to 440 ft2 per Elem.
(1) Brackish Groundwater in the United States (United States Geological Society, 2017)
(2) Information gathered from available manufacturer literature (Nitto Hydranautics, DuPont Filmtec)

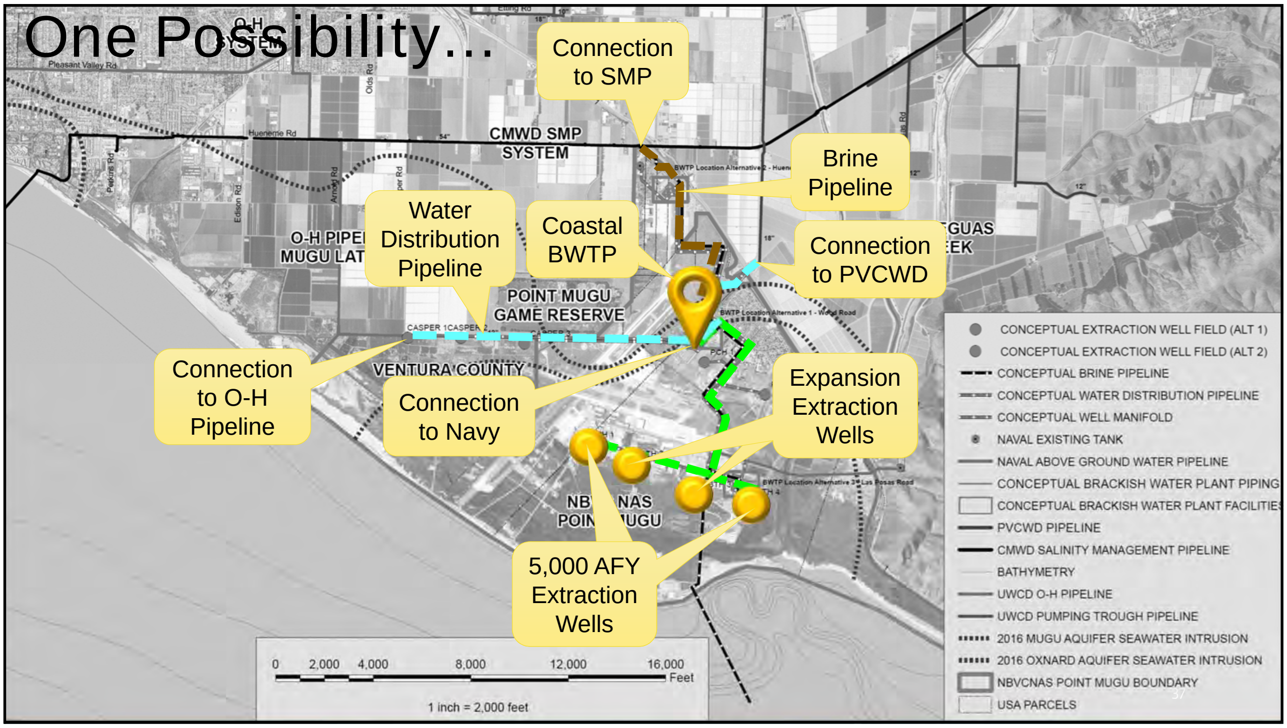

Seawater Intrusion Barrier
Extraction Well Location Alternatives
O-H
SYSTEM
South Oxnard Plain
Brackish Water Treatment
Feasibility Study (Carollo, 2014)
O-H PIPELINE
MUGU LATERAL
POINT MUGU
GAME RESERVE
VENTURA COUNTY
GAME RESERVE
New Study (2019)
NBVC NAS
POINT MUGU
0 2,000 4,000 8,000 12,000 16,000
Feet
1 inch = 2,000 feet


Feasibility Study (Carollo, 2014)
NBVC CBC
PORT HUENEME
O-H
SYSTEM
South Oxnard Plain
Brackish Water Treatment
Feasibility Study (Carollo, 2014)
Feed Water Quality for BWTP Feasibility Study
(Carollo, 2014)
TDS (mgl)
Chloride (mgl)
Sulfate (mgl)
Sodium (mgl)
Magnesium (mgl)
Calcium (mgl)
0
2,000
4,000
6,000
8,000
10,000
12,000
"Worst Case" (Carollo)
"Design" (Carollo)
O-H PIPELINE
MUGU LATERAL
POINT MUGU
GAME RESERVE
10,000 AFY Facility

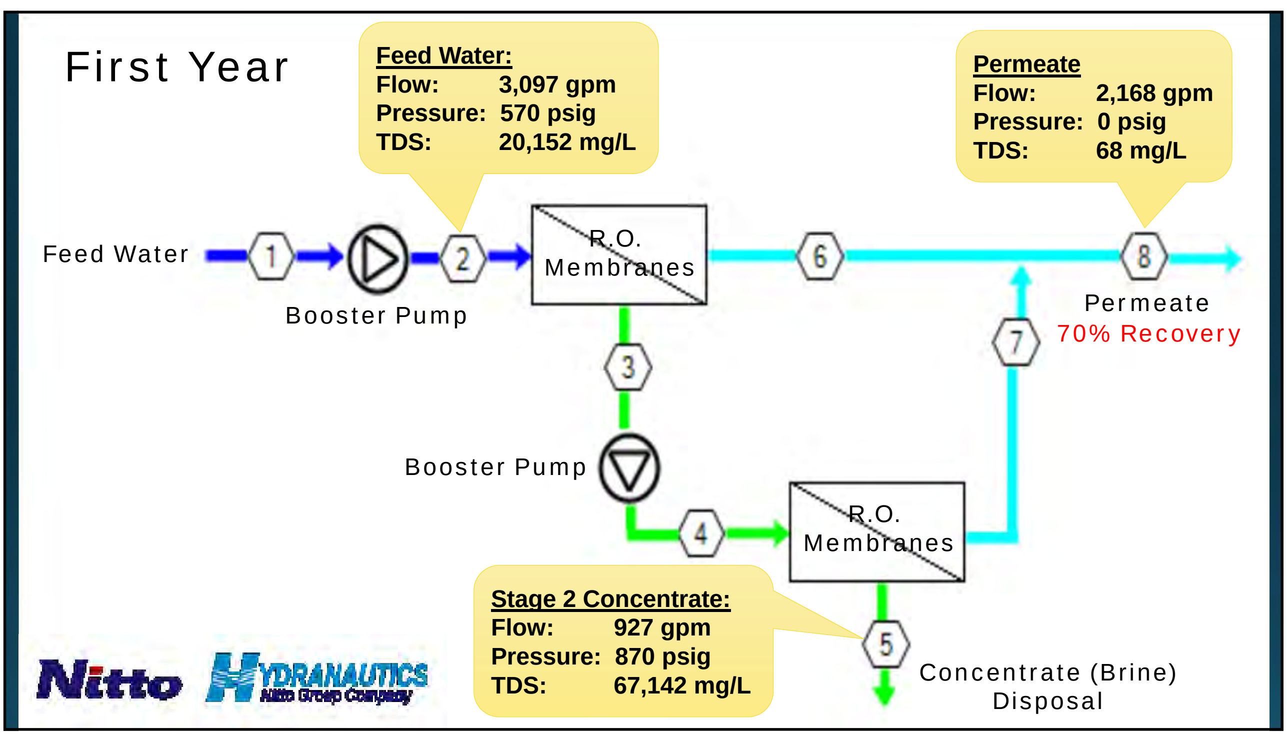

Raw Water Quality for
Coastal BWTP Concept
159
1,080
A1-195
A2-170
462
SW-195
Hueneme Road
SCE-130
39
SCE-220
67
Port
Hueneme
5,520
154
CM4-275
CM4-200
20,400
1,890
CM7-110
CM7-190
92
CM5-220
1,100
SWIFT-205
Monitoring Wells Used to
Represent Raw Water Quality
GP1-240
36
GP2-240
40
374
DP-195
402
Q2-220
2,060
CM6-200
CM1A-220
16,700
Mugu Canyon
Well Location, showing well identification
and chloride concentration (mg/l)
2016 Interpreted Saline Water Intrusion Inland Extent
Highways
Roads, arterials
Bathymetry
2010 TDEM Interpreted Water Quality
Saline
Brackish
Slightly brackish to background
0
0.5
1
2 Miles
N
34


Raw Water Quality for Coastal BWTP Concept
Feed Water Quality for Coastal BWTP Concept
TDS (mgl)
Chloride (mgl)
Sulfate (mgl)
Sodium (mgl)
Magnesium (mgl)
Calcium (mgl)
0
5,000
10,000
15,000
20,000
25,000
Blend (Year 0)
Blend (Year 50)
Approximate Transition between Brackish Water and Seawater Membranes
159
SCE-130 39
SCE-220 67
Monitoring Wells Used to Represent Raw Water Quality
GP1-240 36
GP2-240 40
374
DP-195
402
Q2-220
2,060
CM6-200
CM1A-220
16,700
Mugu Canyon
2 Miles
N
35

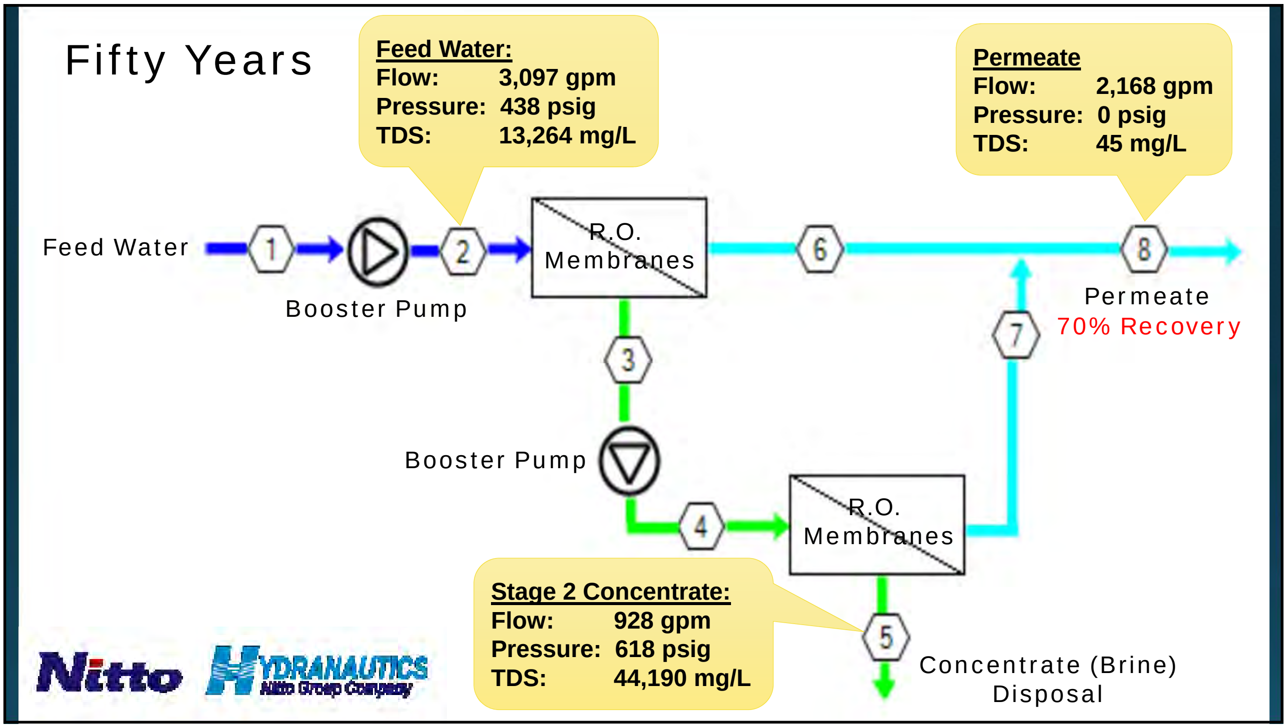

Regional Map
Conceptual Coastal Brackish Water Treatment Plant Locations and Facilities
(FIGURE 1)
PTP SYSTEM
PVCWD SYSTEM
NBVC CBC PORT HUENEME
O-H SYSTEM
CMWD SMP SYSTEM
O-H PIPELINE MUGU LATERAL
POINT MUGU GAME RESERVE
VENTURA COUNTY GAME RESERVE
NBVC NAS POINT MUGU
CALLEGUAS CREEK
CONCEPTUAL EXTRACTION WELL FIELD (ALT 1)
CONCEPTUAL EXTRACTION WELL FIELD (ALT 2)
CONCEPTUAL BRINE PIPELINE
CONCEPTUAL WATER DISTRIBUTION PIPELINE
CONCEPTUAL WELL MANIFOLD
NAVAL EXISTING TANK
NAVAL ABOVE GROUND WATER PIPELINE
CONCEPTUAL BRACKISH WATER PLANT PIPING
CONCEPTUAL BRACKISH WATER PLANT FACILITIES
PVCWD PIPELINE
CMWD SALINITY MANAGEMENT PIPELINE
BATHYMETRY
UWCD O-H PIPELINE
UWCD PUMPING TROUGH PIPELINE
2016 MUGU AQUIFER SEAWATER INTRUSION
2016 OXNARD AQUIFER SEAWATER INTRUSION
NBVCNAS POINT MUGU BOUNDARY
USA PARCELS



One Possibility…
Connection to SMP
CMWD SMP SYSTEM
Brine Pipeline
Water Distribution Pipeline
Coastal BWTP
Connection to PVCWD
POINT MUGU GAME RESERVE
Connection to O-H Pipeline
VENTURA COUNTY
Connection to Navy
Expansion Extraction Wells
5,000 AFY Extraction Wells
0 2,000 4,000 8,000 12,000 16,000 Feet
1 inch = 2,000 feet
CONCEPTUAL EXTRACTION WELL FIELD (ALT 1)
CONCEPTUAL EXTRACTION WELL FIELD (ALT 2)
CONCEPTUAL BRINE PIPELINE
CONCEPTUAL WATER DISTRIBUTION PIPELINE
CONCEPTUAL WELL MANIFOLD
NAVAL EXISTING TANK
NAVAL ABOVE GROUND WATER PIPELINE
CONCEPTUAL BRACKISH WATER PLANT PIPING
CONCEPTUAL BRACKISH WATER PLANT FACILITIES
PVCWD PIPELINE
CMWD SALINITY MANAGEMENT PIPELINE
BATHYMETRY
UWCD O-H PIPELINE
UWCD PUMPING TROUGH PIPELINE
2016 MUGU AQUIFER SEAWATER INTRUSION
2016 OXNARD AQUIFER SEAWATER INTRUSION
NBVCNAS POINT MUGU BOUNDARY
USA PARCELS



First Year
Feed Water:
Flow: 3,097 gpm
Pressure: 570 psig
TDS: 20,152 mg/L
Permeate
Flow: 2,168 gpm
Pressure: 0 psig
TDS: 68 mg/L
Feed Water
1
Booster Pump
2
R.O. Membranes
6
8
Permeate
70% Recovery
7
3
Booster Pump
4
R.O. Membranes
Stage 2 Concentrate:
Flow: 927 gpm
Pressure: 870 psig
TDS: 67,142 mg/L
5
Concentrate (Brine) Disposal
Nitto
HYDRANAUTICS
Nitto Group Company



Post-Treatment Water Quality Considerations

Parameters	Drinking Water Requirements	Agricultural Requirements	
		Slight to Moderate Yield Loss	Severe Yield Loss (Crop Growth Ceases)
Electrical Conductivity (EC) [dS/m]	0.9 – rec. limit (2) 1.6 – upper limit (2) 2.2 – short-term limit (2)	0.9 to 1.7 – strawberries (3) 1.6 to 3.2 – oranges (3) 2.3 to 6.6 – celery (3)	>2.7 – strawberries (3) >5.3 – oranges (3) >12 – celery (3)
Total Dissolved Solids (TDS) [mg/L]	500 – rec. limit (2) 1,000 – upper limit (2) 1,500 – short-term limit (2)	450 – 2,000 (4)	> 2,000 (4)
Chloride [mg/L]	250 – rec. limit (2) 500 – upper limit (2) 600 – short-term limit (2)	105 – 350 (4)	> 350 (4)
Nitrate (as Nitrogen) [mg/L]	10 (1)	5 – 30 (4)	> 30 (4)
Boron [mg/L]	None	0.7 – 3.0 (4)	> 3.0 (4)

(1) Primary Maximum Contaminant Levels (California State Water Resources Control Board, 2018)
(2) Secondary Maximum Contaminant Levels (California State Water Resources Control Board, 2018)
(3) Water Quality for Agriculture (Ayers and Westcot, 1985)
(4) Technical Guidelines for Irrigation Suitability Land Classification (U.S. Bureau of Reclamation, 2005)

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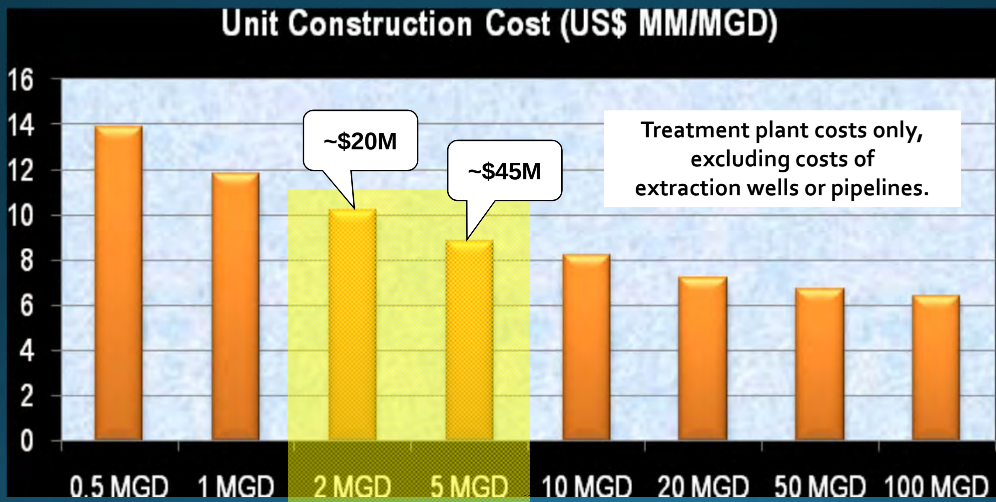
Potential Capital Costs



Reference: Seawater Desalination Costs. WateReuse Association. January 2012.

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Seawater RO Desalination Costs

Plant Capacity, Location	Online Since	Capital Cost	Annual O&M Cost per 1000 gal	Cost of Water per 1000 gal	Cost of Water per Acre-foot
0.6 MGD Sand City, CA	2010	$11.9 M	$2.6	$4.2	$1,369
25 MGD Tampa Bay, FL	2008	$138 M	$1.4	$3.6	$1,173
50 MGD Carlsbad, CA	2015	$860 M	$3.6	$6.5	$2,118
7.5 MGD (8,400 AFY) Santa Barbara, CA	2017	$48 M	$2.2	$4.4	$1,434

Reference: N. Voutchkov, PE, BCEE, Water Global Consultants, Seawater Desalination Current Status and Trends May 13, 2019

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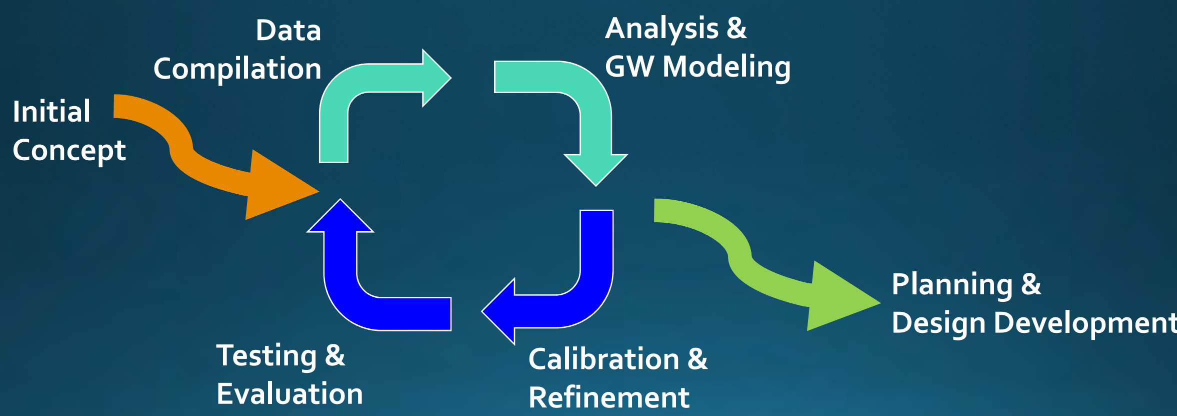
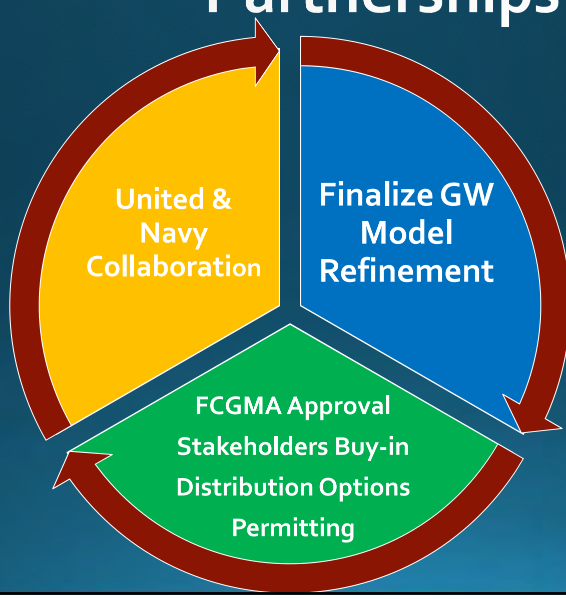
Path Forward – Data Processing



Path Forward – Continue Building Partnerships



Path Forward - Engineering

Key Design Considerations

- Environmental Impact Analysis and Permitting
- Extraction Wellfield Size
- Coastal BWTP Capacity and Location
- Feed Water Quality
- Treated Water Quality Goals and Distribution Options
- Brine Discharge Alternatives
- Pilot Testing to Confirm Design Criteria
- Design Development
- Construction

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9. Future Agenda Items

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10. Adjournment

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